XCube Project

USE OF U-CLASS STANDARD FOR EMBEDDED EXPERIMENTS

A CLEAN AND COST EFFECTIVE PATH, FROM LABS TO ORBIT

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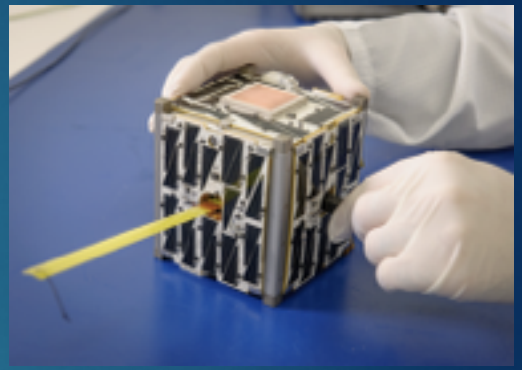
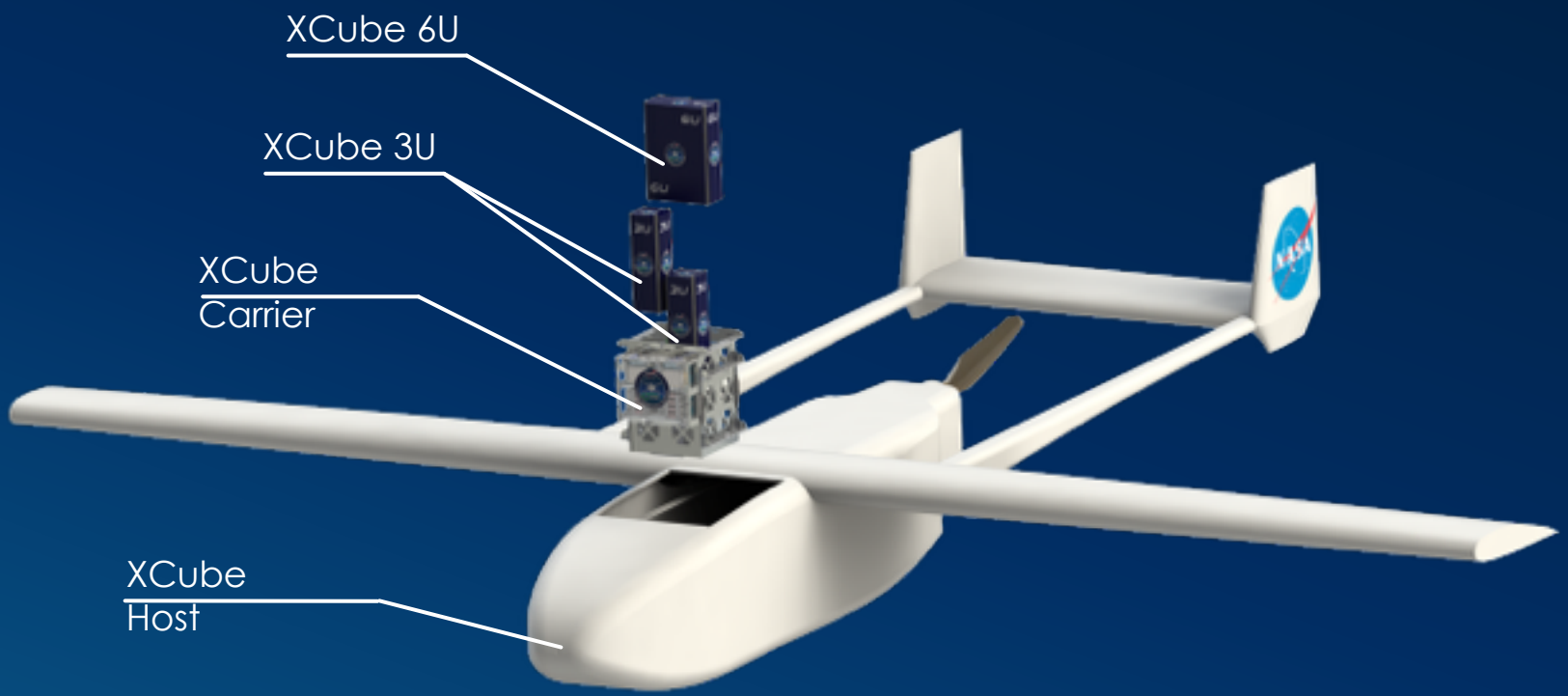
Motivation

- Development of the CubeSat standard has enabled a vibrant new ecosystem of nanosatellite development and missions
  - Predicated on "ride along" opportunities
  - Very low cost to orbit
  - Greater tolerance for risk
  - Simple integration with launch vehicle
- Started with universities, now adopted by global community including government, industry, and private individuals
- Commercial supply chain has developed & matured
  - Many components available off the shelf
  - Further enables cost reduction, speeds development time

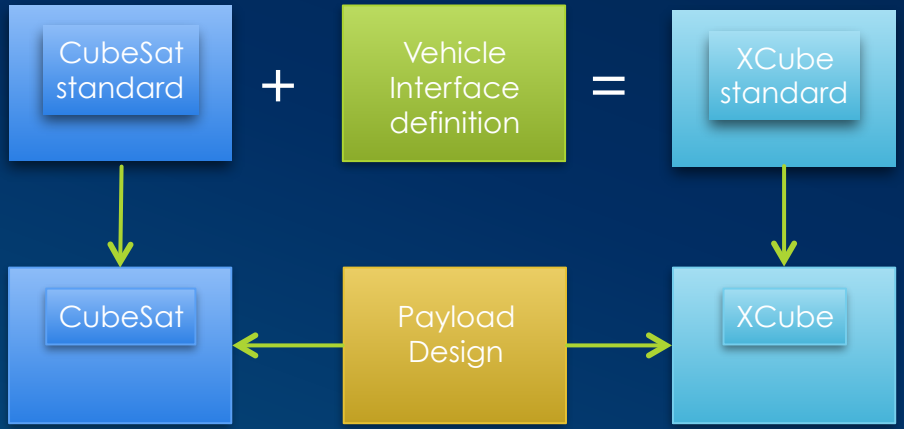


How can we replicate and leverage the CubeSat standard for airborne payloads?

XCube, XCube Carrier, XCube Host



XCube, CubeSat, what is the difference ?



XCubes are U-Class experiments (they use the same form factor as CubeSats) They are designed to fly inside a Host vehicle (Aircraft, Balloon, Rocket, Spacecraft)

XCubes can be independent, but typically would use the power supply and communication system provided by the Host

What are the different aspects of the project ?

Carrier and Host couples

XCube development

Online Database

XCube Standard

Top

Side | Front

XCube interface

1U 3U 6U 12U

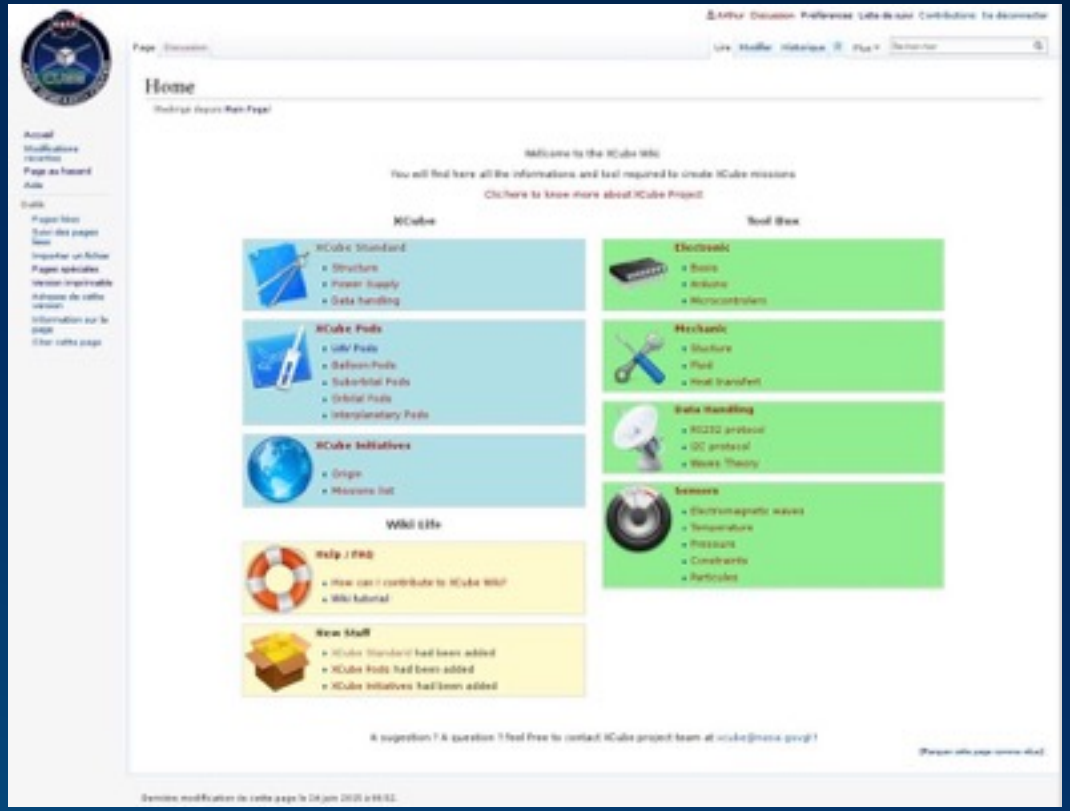
XCube Wiki - XCube Online Database

Meeting point of the XCube community

Practical information on :

> How to build XCube experiment

> How to fly XCube experiment



Candidate Host vehicles

Global Hawk

ER-2

Ikhana

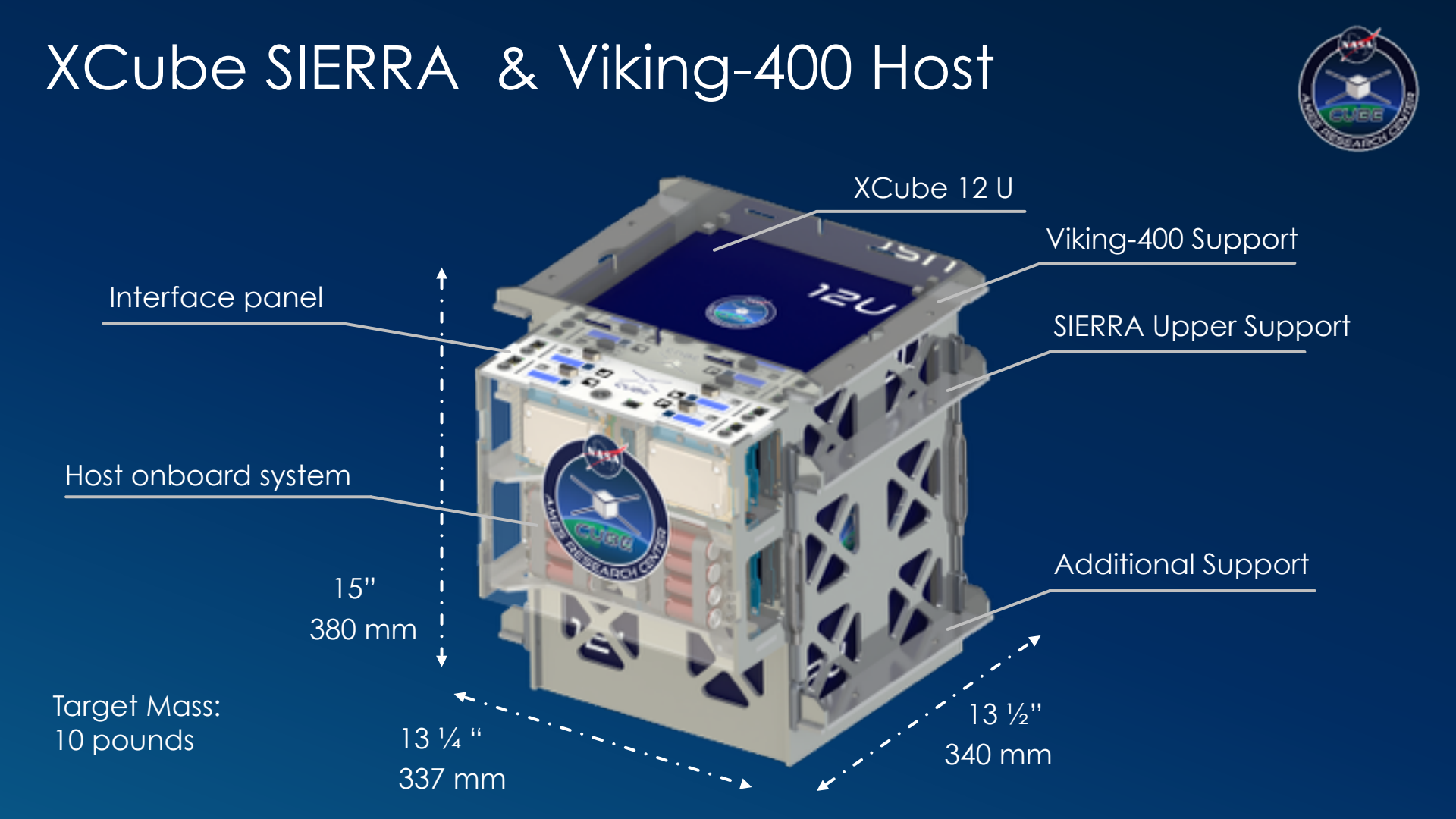
SIERRA/Viking-400 Host

Balloon

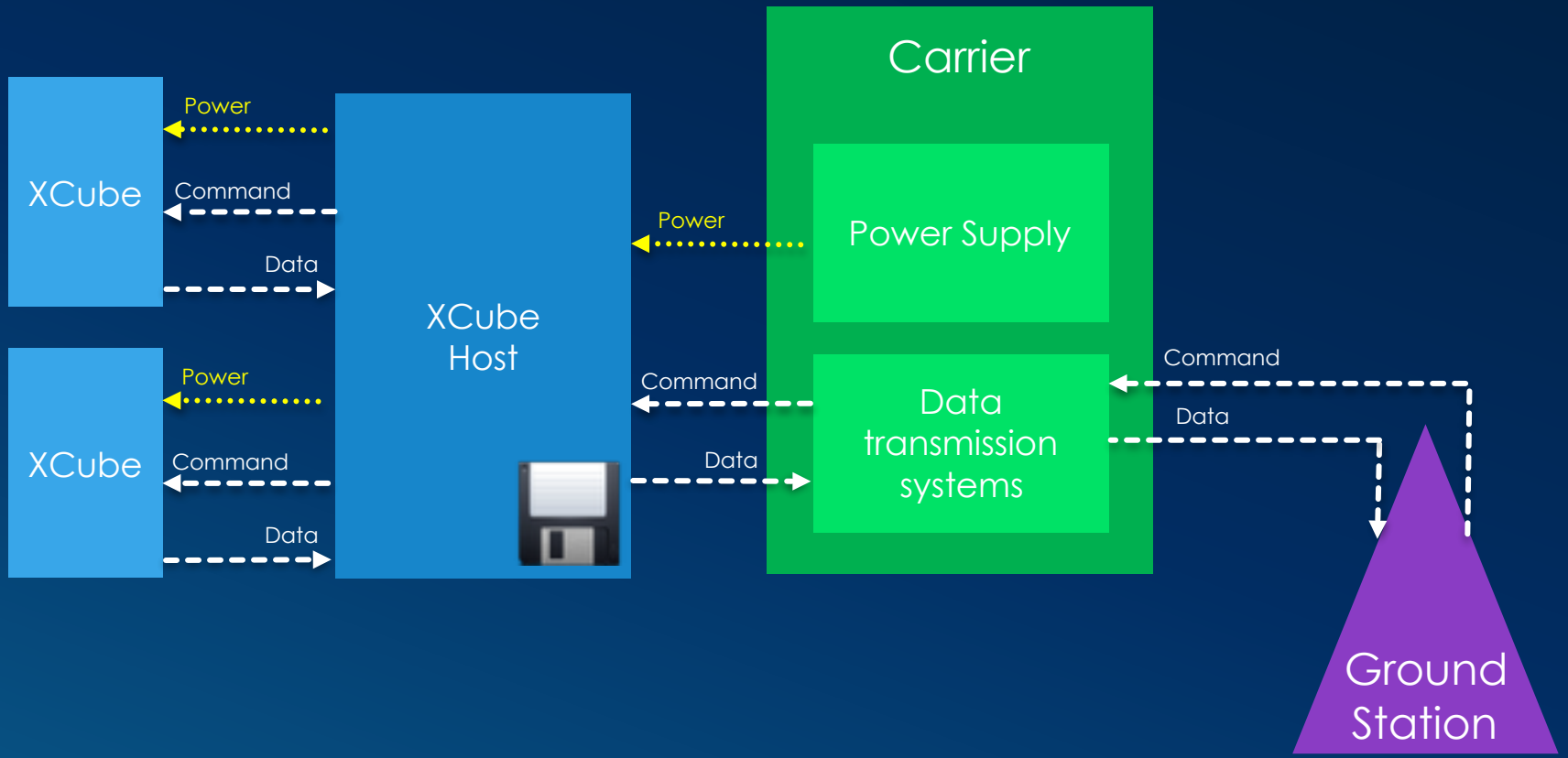
Viking-400

SIERRA

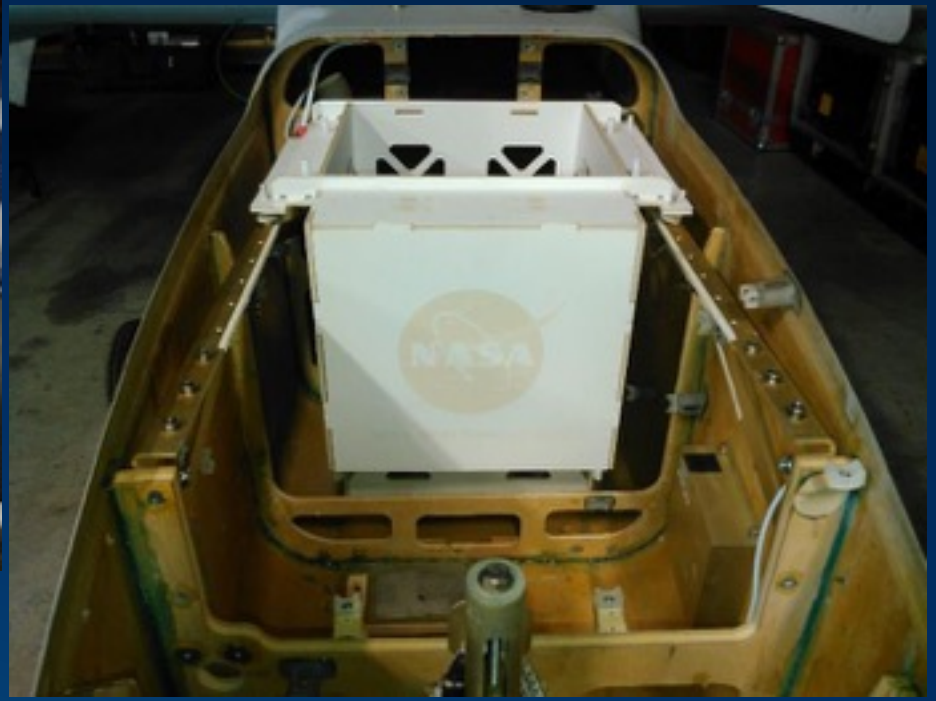
XCube SIERRA & Viking-400 Host



Interfaces


Carrier
Power Supply
Data transmission systems
XCube Host
XCube
XCube
Power
Command
Data
Power
Command
Data
Power
Command
Data
Command
Data
Ground Station

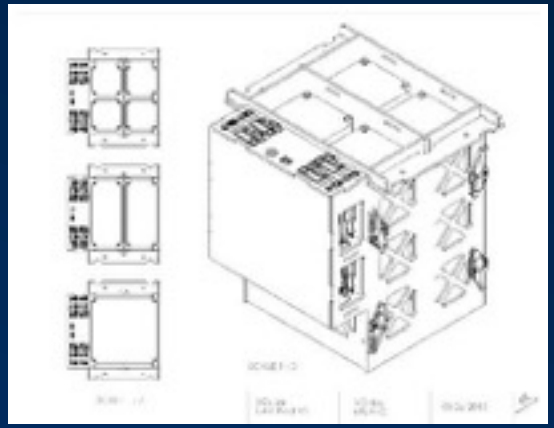
Test fit in SIERRA and Viking-400



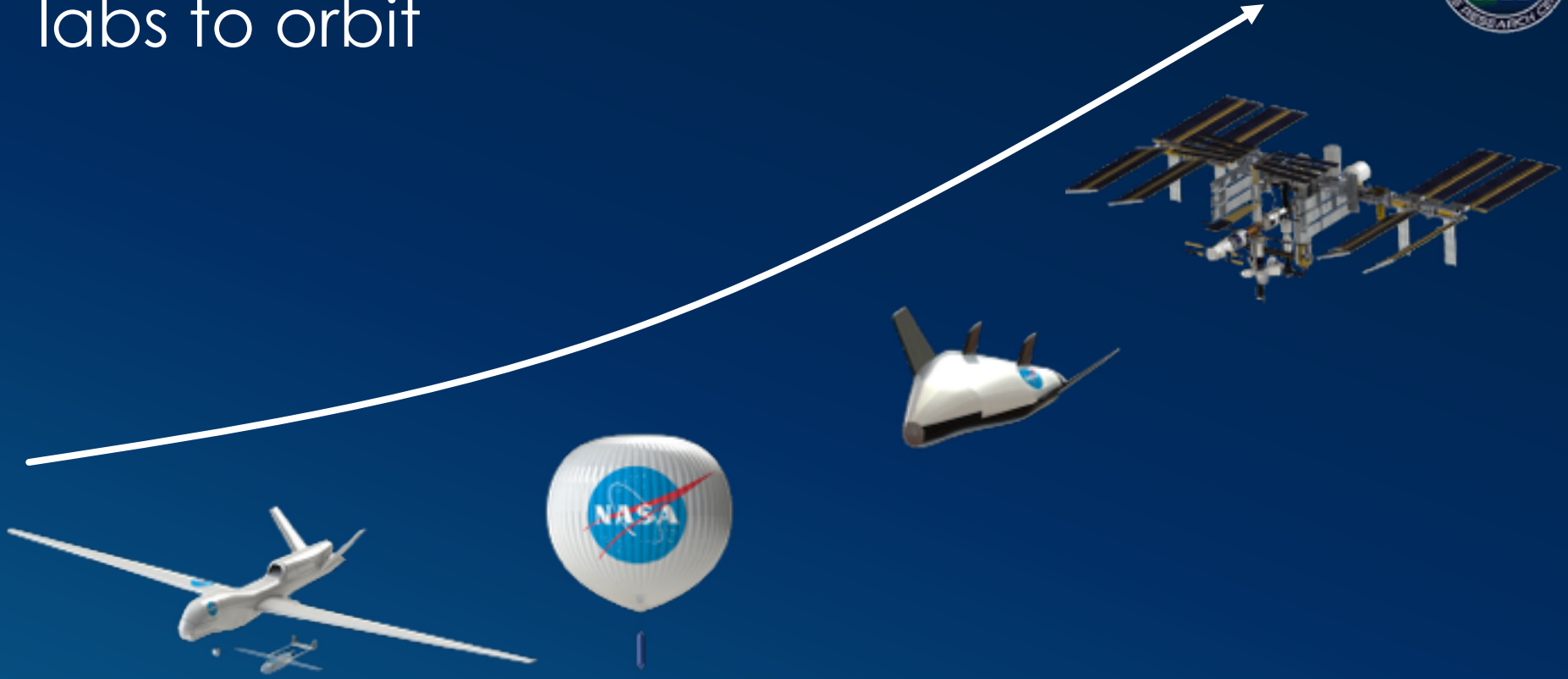
Innovation

Unique advantages include:

- Modular – Easy to manufacture using rapid prototyping equipment.
- Will make collaboration much simpler by providing a standard for experiments based on the well-established Cubesat form factor and interface.
- It will also help researchers by providing cost effective access to NASA flying vehicles.
- The use of Cubesat form factor and the use of rapid prototyping to design Pods and payloads, compatible with widely available commercial CubeSat boards



A clean and cost effective path from labs to orbit



XCube advantages

- Based on CubeSat: Well-known standard with large, supportive community
- Experimenters can take advantage of CubeSat COTS components to reduce development time and cost
- Allows experimenters to develop payload in the lab, with easy integration for flight
- Provides easy, standardized access to broad range of flight environments (low to high, slow to fast, short to long)
- Same path leads to orbit

Proof of concept:

XCube Recon Project

ESTACA/NASA AIRBORNE XCUBE PROJECT

DEMONSTRATE POSSIBILITIES OF XCUBE CONCEPT

Team members and Tasks

Yanomi deOliveira

- Camera - Raspberry Programing
- Arduino Programing
- Integration
- Xcube Tab Programing

Pierre Foulon

- Network architecture
- Main computer
- Raspberry Programing
- Beagle Bone programing

Valentin Abt

- Thermal regulation system
- CAD
- Integration
- Machining

Aurore Piazza

- Thermal regulation system
- Tests
- Soldering

Paul Malaurie

- Partnership
- Procurement
- Management
- Test

Noureldine Amir-Taha

- CAD
- Raspberry programing
- Arduino Programing

Arthur Descamps

Project Leader

- Structure
- Arduino Programing
- Raspberry programing
- Beagle bone programing
- Integration
- Tests

Benoit Sagot

ESTACA Researcher

Provide technical support and advise to the team

ESTACA Contribution, XCube Recon

First XCube prototype, XCube Recon is a 3U XCube that aims to pave the way for XCubes onboard XCube Hosts and Carriers.

- Goals :

1. Environment Characterization

➢ Attitude determination
➢ Vibration levels
➢ Thermal Environment
➢ H2O Environment

2. Secondary goal

➢ Air analysis

3. Tertiary goal

➢ Record images

2.2 Kg

15 W

ESTACA
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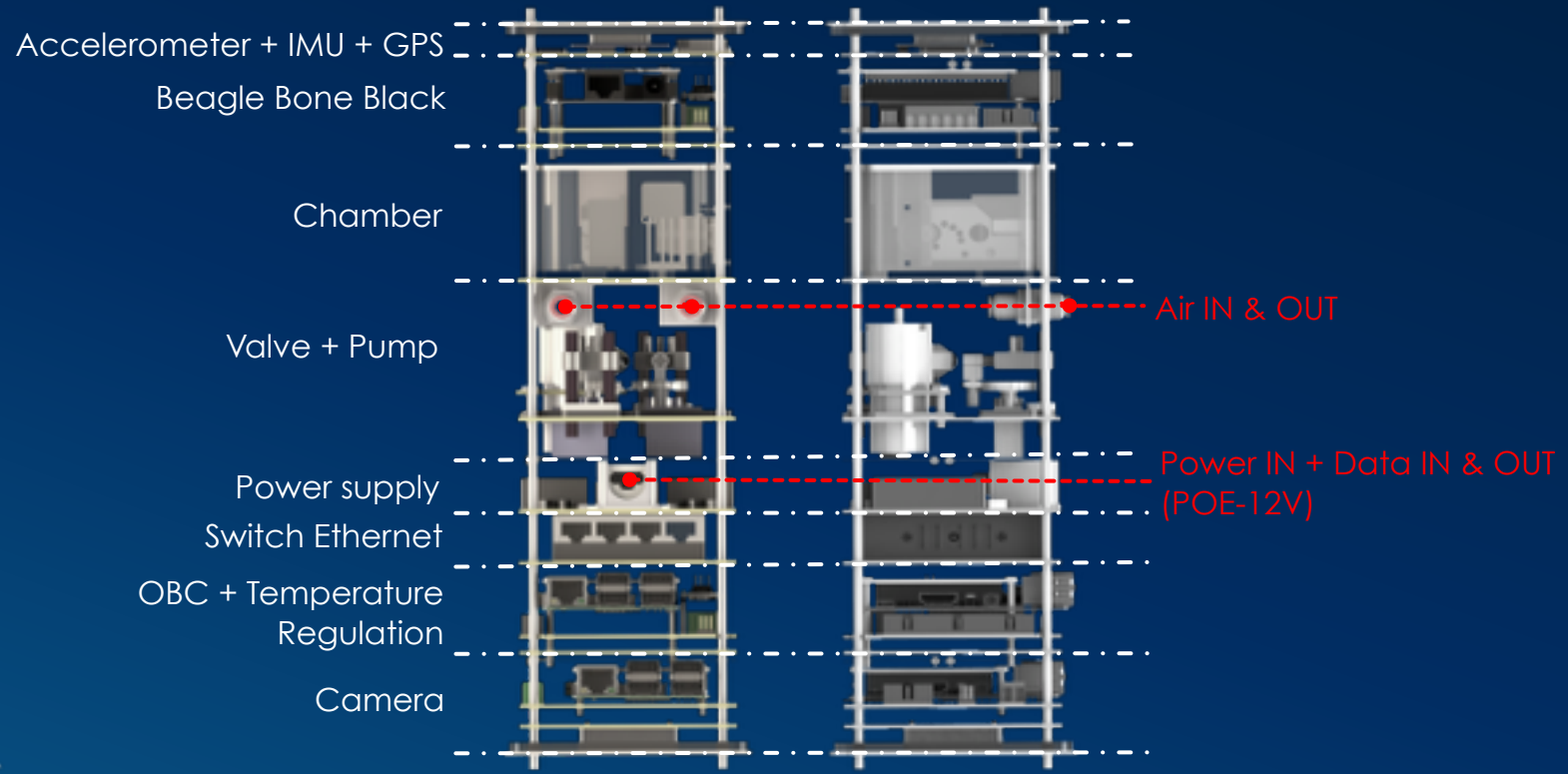
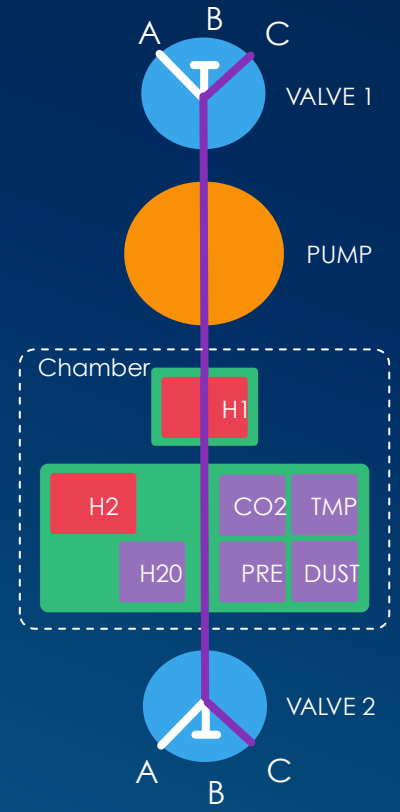
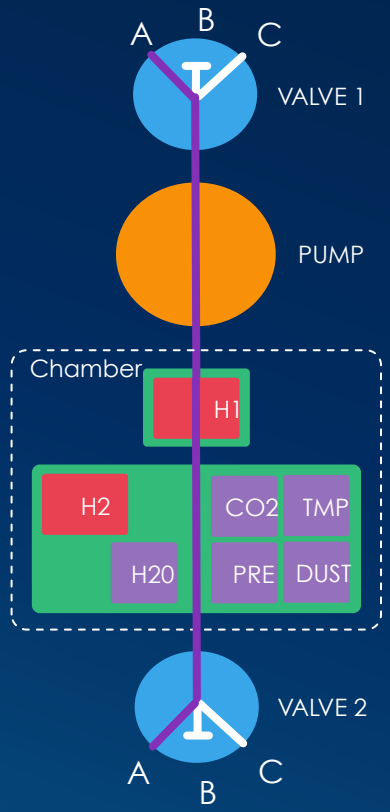
Mechanical Architecture



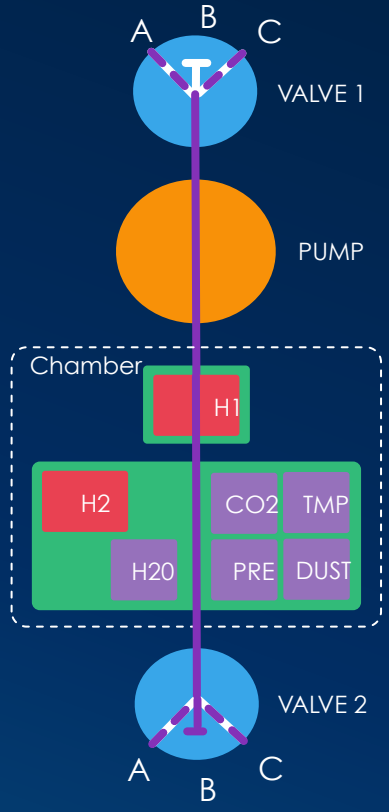
Example: Air sampling experiment



Mode : Internal Air Source

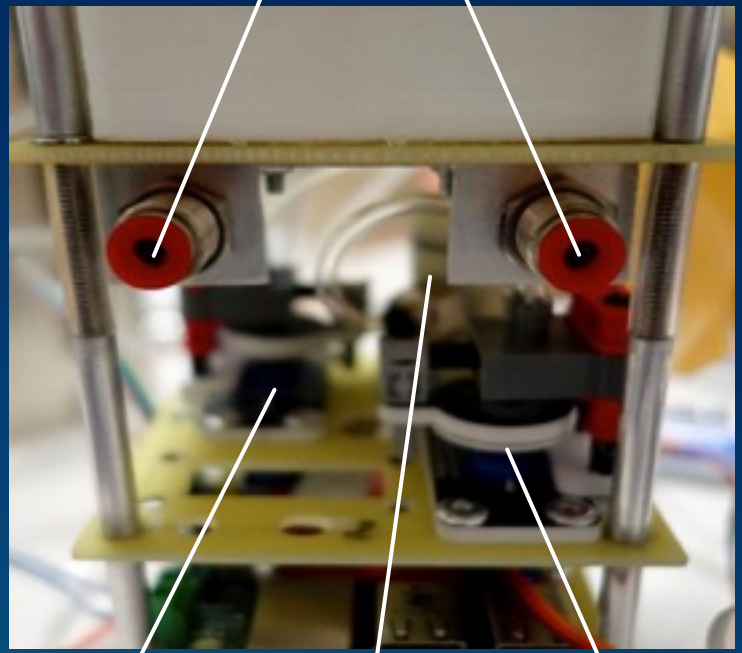


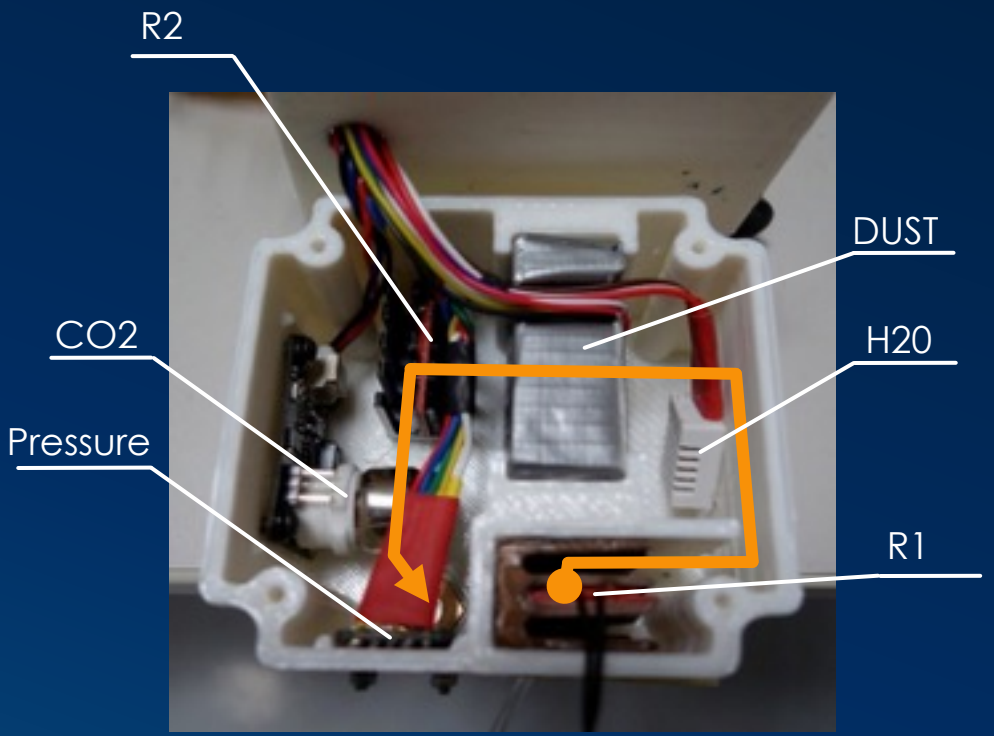
Mode : External Air Source



Mode : Pressure control

Air sampling experiment





Current status

- Example carrier (for up to 12U) developed for small NASA UAS
- Proof-of-concept Xcube payload developed at ESTACA
- Seeking feedback on concept, interest from community

Thank you for your attention

Do you have any questions ?